REMARKS

Status of this application

Claims 1-19 and 22-32 are currently pending in this application. In the Office Action mailed on August 2, 2005:

(a) Claims 1, 9-12, 15-19, 22-25, and 29-32 were rejected under 35 U.S.C. 103(a) as being unpatentable over the article by Arnold et al. entitled "Virtual Teeth for Endodontics Training and Practice" (hereinafter "Arnold") in view of U.S. Patent 6,191,796 issued to Christopher Tarr (hereinafter "Tarr") and further in view of the NASA Tech Brief dated October 1998 entitled "Haptic Technologies' PenCAT/Pro 3D pen" (hereinafter "PenCAT").

(b) Claims 2-8, 13-14, and 16 were rejected under 35 U.S.C. 103(a) as being unpatentable over Arnold in view of Tarr and PenCAT and still further in view of Hayka et al Patent 5,688,118 (hereinafter "Hayka").

(c) Claims 26-28 were indicated to be allowable if rewritten in independent form.

The Obviousness Rejection based on Arnold in view of Tarr and PenCAT

Claims 1, 9-12, 15-19, 22-25, and 29-32 were rejected under 35 U.S.C. 103(a) as being unpatentable over Arnold in view of Tarr and PenCAT. Reconsideration is requested since none of the references relied upon disclose any of several elements of the invention clearly recited in independent claims 1 and 19.

In characterizing the principle reference, the Examiner suggested that Arnold discloses "employing the digital computer and display device to display a model of a dental tool." But neither Arnold nor any of the other cited references discloses or suggests that a model of a dental tool having a handle be displayed and represented by a plurality of feel points used to calculate the forces applied to a force feedback stylus that simulates the modeled handle of the dental tool. Contrary to the Examiner's suggestion, Arnold does not display a model of a dental tool, and certainly not a model of the type expressly claimed by applicants.

As set forth in amended claim 1, applicants' method for simulating dental procedures includes the step of "storing point data defining the positions of a plurality of feel points that define the surface of a model of a dental tool having a handle" and "employing said processor and said display device to display said model of a dental tool having a handle."

Arnold, at the bottom of page 601 to top of page 602, describes a "haptic viewer" and states that *"the device can create the necessary forces as the user moves the cursor over the Force Mesh"* but there is no indication that this "cursor" is even visible on the display screen since Arnold goes on to state that *"This provides an almost solely touch oriented interaction as the only visible data is a wireframe representation of the Force Mesh* [representing the tooth]. *The final stage is therefore to replace this visual representation of the Force Mesh with the original model whilst retaining the generated forces. This enables the user to see the original model* [of the tooth, not the tool] *while feeling the Force Mesh through the PenCAT."* It is thus submitted that Arnold does not display a model of a tool, and certainly does not display anything that could be said to be a "model of a tool having a handle" as claimed.

Moreover, nothing in the Arnold disclosure discloses or suggests the step set forth in claim 1 of "storing point data defining the positions of a plurality of feel points that define the surface of a model of a dental tool having a handle." The Examiner concedes that Arnold does not store point data defining the positions of a *plurality of feel points that model the surface of the dental tool,* but contends that "there must be *at least one point data* stored defining the position of a feel point that models the surface of the dental tool in order to detect a collision between the dental tool and a tooth model. Applicant agrees that Arnold does employ a data point that represents the position of the (apparently invisible) "cursor" which Arnold compares with the tooth model force mesh data to determine the feedback force which the user feels through the PenCAT as "bumps and ridges." But this single point plainly does not constitute a plurality of feel points that defines the surface of a surface of a model of a dental tool having a handle as claimed.

The use of a plurality of feel points to model a dental tool having a handle is important. Claim 1 recites the further step of "employing said processor to compare said location of at least one isosurface in said model of a tooth with said positions of said feel

points that define the surface of a model of a dental tool having a handle to calculate and apply computer-controlled interaction forces <u>to said force-feedback stylus to simulate the feel of said dental tool having a handle</u> to haptically simulate a dental procedure." As explained in applicant's specification at pages 7 and 10, the use of plural feel points to model the surface of a dental tool having a handle permits interaction forces to be applied to the force-feedback stylus so that the user can feel virtual tool / virtual object interaction forces with the handle portions of the tool, and further permits the force feedback system to simulate torque forces applied to the handle, such as those produced during tooth extraction.

None of the cited references disclose modeling the surface of a dental tool having a handle. As pointed out by the Examiner, the newly cited Tarr patent discloses a method for haptically deforming a virtual surface in a virtual environment, wherein a haptic tool is modeled as a *plurality* of discrete points in order to form the volumetric shape of the tool (col. 5, lines 41-46). But Tarr does not describe modeling dental procedures, modeling a tooth, or modeling a dental tool having handle. Tarr employs data that models a "tool" either as a sphere, a cuboid, a toroid, or other volumetric representation defined by an implicit function (see col. 16, lines 29-32), by a volumetric shape represented by a series of discrete points (col. 5, lines 41-46), or by voxelized volumes (col. 16, lines 62-65). But Tarr does not describe modeling any kind of tool having a handle, does not describe displaying a model of a tool having a handle, and does not describe computing forces that should be applied to the force feedback stylus handle by comparing the position of a modeled tooth surface with the positions of plural feel points representing a tool model having a handle in order to simulate the feel of said dental tool having a handle as claimed.

Because neither Arnold, nor Tarr, nor the PenCAT, nor Hayka, discloses or suggests modeling a tool having a handle with data representing the positions of plural feel points, because none of these references discloses simulating the feel of said dental tool having a handle by calculating and applying forces to a force-feedback stylus based on the relative positions of these feel points and the surface of a tooth model as claimed, there is no basis for concluding that the subject matter set forth in independent claims 1

and 19 (and the remaining dependent claims) would be obvious in view of these references. As stated in M.P.E.P. Section 2143.03:

> "To establish prima facie obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. *In re Royka,* 490 F.2d 981, 180 USPQ 580 (CCPA 1974). "All words in a claim must be considered in judging the patentability of that claim against the prior art." *In re Wilson,* 424 F.2d 1382, 1385, 165 USPQ 494, 496 (CCPA 1970). If an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious. *In re Fine,* 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988).

With respect to claim 16 (which is dependent on claims 1 and 14), and claim 17 (which is dependent on claims 1 and 15) and its dependent claim 18, and claims 22-23 (which are dependent on claim 19) and claim 24 (which is dependent on claims 22-13), the Examiner suggests that Arnold teaches responding to the movement of a model of a dental tool with respect to the model of the tooth by modifying volumetric data at pages 601-603. No such teaching has been found. Arnold describes how a force mesh model of a tooth can be constructed from a VRML file, and how the resultant force mesh can be used to apply forces to t he PenCAT as the cursor is moved over the force mesh, and how the tool flexes and "bends around corners" (pages 602-603) but does not suggest modification of the tooth model.

With respect to claims 30-32 (which are dependent on claims 22 and 23 that is allowable for the reasons given above), the Examiner suggests that Arnold discloses that the tool definition data includes the specification of the location of sensor points relative to a modification region of the kind specified in claim 22. As previously noted, Arnold does not disclose a modification region, and does not disclose the location of sensor points relative to a modification region (claim 30), does not disclose that a sensor point located at the center of mass of a modification region (claim 31), and does not disclose sensor points at or near the location of one or more selected feel points (claim 32).

The foregoing dependent claims which have been rejected on the combination of Arnold, Tarr and PenCAT are accordingly believed to be allowable because each sets forth subject matter that is not taught in the references relied upon by the Examiner.

The Obviousness Rejection further in view of Hayka

Claims 2-8, 13-14, and 16 were rejected under 35 U.S.C. 103(a) as being unpatentable over Arnold in view of Tarr and PenCAT and still further in view of Hayka et al Patent 5,688,118. Tarr and the PenCAT reference do not discuss dentistry at all, and the Examiner concedes that Arnold does not disclose displaying and manipulating models of dental tools having handles of the type claimed (i.e. a pick having a pick handle (claim 2), a drill having a drill handle (claim 3), an amalgam carrier having a carrier handle (claim 4), carver having a carver handle (claim 5), a tool model selected by a student from a plurality of available tools, each of which has a handle (claims 6-8), and models of dental tools having handles set forth in claims 13, 14 and 16.

Moreover, none of the references teaches removing portions of a tooth model that are intersected by a model representing a drill (claim 13), or adding material to portions of a tooth model in the vicinity of a model of an amalgam carrier (claim 14).

As the Examiner points out, Hayka discusses dental procedures, but the Hayka system employs an actual dental drill together with means for varying the flow of compressed gas to the drill to vary its speed of rotation to simulate drilling a real tooth having regions of different hardness when drilling an artificial tooth whose hardness does not vary. Hayka states that the position sensor could be attached to a "chisel, angle former, enamel hatchet, etc." as suggested at column 12, lines 10-40, but there is no mechanism disclosed for modeling these tools with a plurality of feel points as claimed, or for using these position of these feel points to apply calculated forces to the Hayka handpiece, or for using calculated forces to simulate the feel of an actual tool. The only forces felt by the student using the Hayka system would be those created by the direct collision of the actual tool with the artificial tooth, not calculated forces which simulate the feel of an actual tool as claimed. In short, there is nothing in the Hayka teaching that suggests that one could or should attempt to model a dental tool having a handle with plural feel points to simulate the feel of a real tool as claimed. If anything, Hayka instead teaches that actual tools and actual teeth be employed to model dental procedures.

Allowable Subject Matter

The allowability of claims 26-28 if rewritten in independent form is noted. For the reasons submitted above with respect to the allowability of these claims' parent claims 19, 22, 23 and 24, there is not need to write them in independent form.

Conclusion

Reconsideration and allowance of claims 1-19 and 22-32 in view of the foregoing amendments and remarks is respectfully requested.

Respectfully submitted,

Dated: January 8, 2006   Charles G. Call, Reg. 20,406

Certificate of Transmission under 37 CFR 1.8

I hereby certify that this AMENDMENT is being transmitted by facsimile to the central fax number of the U.S. Patent and Trademark Office, (571) 273-8300 on January 8, 2006.

Dated: January 8, 2006   Signature _____
                                     Charles G. Call, Reg. No. 20,406
                                     USPTO Customer No. 021253
                                     68 Horse Pond Road
                                     West Yarmouth, MA 02673
                                     Ph. (508) 778-2630 Fax (508) 629-6540
                                     call@patentsoft.com

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